

The Periodic Table of Elements, Ions and the Ionic Bond.

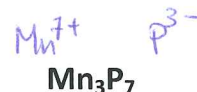
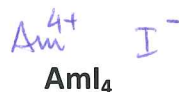
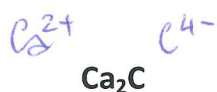
1. Periodic table and periodic properties of elements

a. Rank the following species according to their properties. (1 = highest, 4 lowest)

	Se ²⁻	H	Se	C
Radius	1	4	2	3
Ionization Energy	3	1	4	2
Electron Affinity	4	2	1	3
Electronegativity	4	3	1 *	1 *

* Same exact values.

2. Assign to every atom of the following ionic compounds its formal charge.



3. Write two possible compounds for the following pairs of elements.



4. Calculate the lattice energy of the following crystals:

i. 2.5g of Cesium Chloride (CsCl)

$-1.0 \times 10^7 \text{ J}$

ii. 14.6g of rutile (TiO₂)

$-1.64 \times 10^9 \text{ J}$

5. Fill the table below in, with the missing electron configurations and give an explanation for the trends in the first Ionization Energy; possible trends are :

a. Z increases

c. New shell

b. Electron –electron repulsion

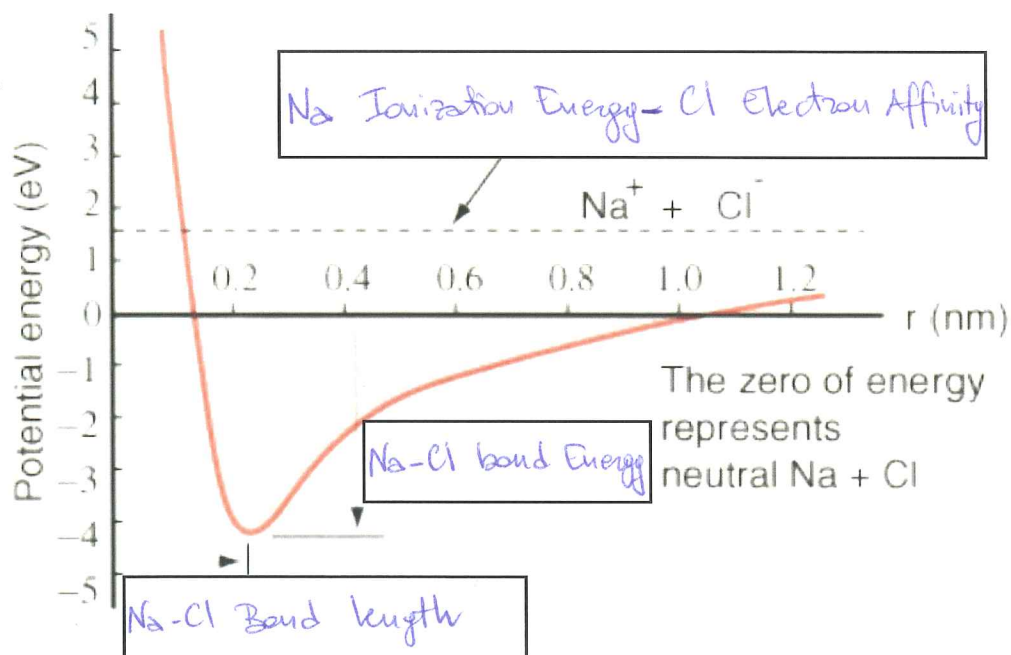
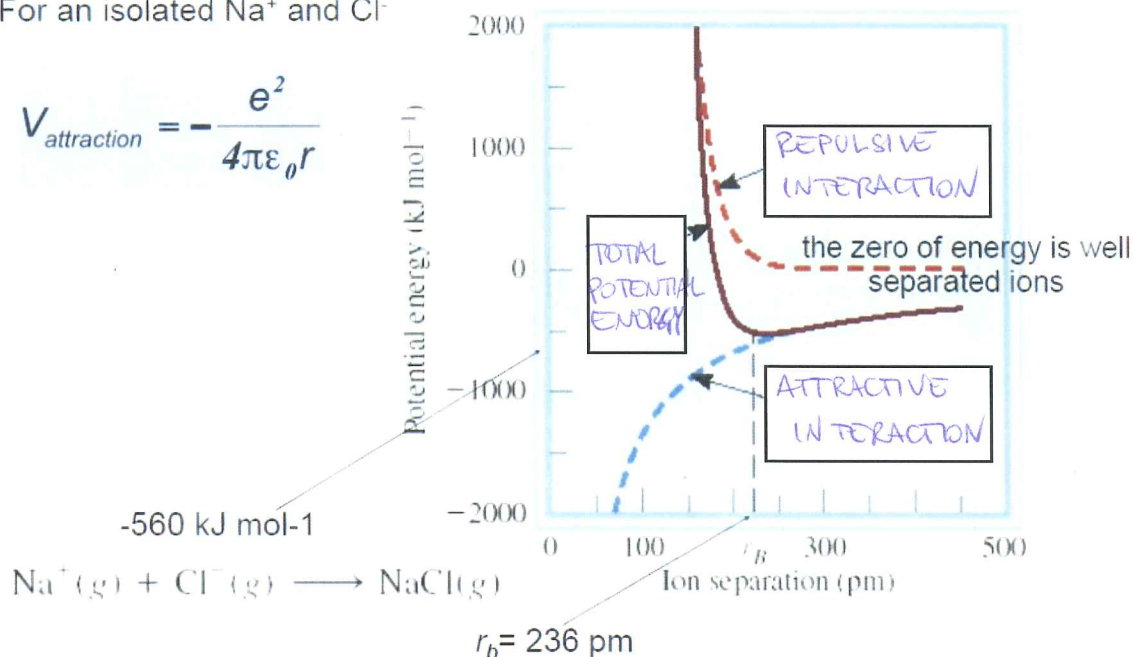
d. / increases or Z_{eff} decreases (shielding)

Atom	Z	Electron configuration	IE_1 $\frac{kJ}{mol}$	Trends in IE_1 Explanation	Ions	IE_2 $\frac{kJ}{mol}$
He	2	$1s^2$	2373	a.	He^+ $1s^1$	5248
Li	3	$1s^2 2s^1$	520	c. d.	Li^+ $1s^2$	7300
Be	4	$1s^2 2s^2$	899	a.	Be^+ $1s^2 2s^1$	1757
B	5	$1s^2 2s^2 2p_x^1$	801	d.	B^+ $1s^2 2s^2$	2430
C	6	$1s^2 2s^2 2p_x^1 2p_y^1$	1086	a.	C^+ $1s^2 2s^2 2p_x^1$	2350
N	7	$1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$	1400	a.	N^+ $1s^2 2s^2 2p_x^1 2p_y^1$	2860
O	8	$1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$	1314	b.	O^+ $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$	3390
F	9	$1s^2 2s^2 2p_x^2 2p_y^2 2p_z^1$	1680	a.	F^+ $1s^2 2s^2 2p_x^2 2p_y^1 2p_z^1$	3370
Ne	10	$1s^2 2s^2 2p_x^2 2p_y^2 2p_z^2$	2080	a.	Ne^+ $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^1$	3950
Na	11	$[Ne] 3s^1$	496	c. d.	Na^+ $1s^2 2s^2 2p_x^2 2p_y^2 2p_z^2$	4560
Mg	12	$[Ne] 3s^2$	738	a.	Mg^+ $[Ne] 3s^1$	1450
Al	13	$[Ne] 3s^2 3p_x^1$	578	d.	Al^+ $[Ne] 3s^2$	1820

6. Fill the blank boxes of the pictures below with the appropriate descriptor for the relative curve:

For an isolated Na^+ and Cl^-

$$V_{\text{attraction}} = -\frac{e^2}{4\pi\epsilon_0 r}$$



7. The percent ionic character of a bond can be approximated by the formula $16\Delta\chi + 3.5\Delta\chi^2$, where $\Delta\chi$ is the difference between the Pauling electronegativity values of the two elements. Calculate the % ionic character of the following molecules and give a qualitative explanation (in words) of why that makes sense according to the electron configuration of the atoms/ions.

HF $\sim 40\%$

HCl $\sim 19\%$

HBr $\sim 14\%$

HI $\sim 8\%$

CsF $\sim 87\%$

8. Given the following information:

Energy of sublimation of Li(s) = 166 kJ/mol

Electron affinity of Cl (g) = -349 kJ/mol

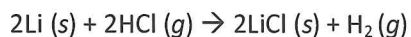
Bond energy of HCl = 427 kJ/mol

Lattice Energy of LiCl(s) = -829 kJ/mol

Ionization energy of Li(g) = 520. kJ/mol

Bond Energy of H₂ = 432 kJ/mol

Calculate the net change in energy for the following reaction:



$$E = E_{\text{sub}} + E_{\text{bond HCl}} + E_{\text{lattice}} + IE_{\text{Li}} - \text{Energy}_{\text{bond H}_2} =$$

$$= 166 + 427 + 520. - 829 - 432 = -148 \text{ kJ/mol}$$

Energy needed
to go from
Li(s) to Li(g)